

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

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24 JAN 2005

Hanna, Moore & Curley

**NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

(PCT Rule 71.1)

Date of mailing
(day/month/year)

20.01.2005

Applicant's or agent's file reference
M10-185-13

IMPORTANT NOTIFICATION

International application No.
PCT/EP 03/08354

International filing date (day/month/year)
29.07.2003

Priority date (day/month/year)
01.08.2002

Applicant
MICROSAIC SYSTEMS LIMITED et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed inventions is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the international preliminary examining authority:



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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Article 36 and Rule 70)

Applicant's or agent's file reference M10-185-13	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA416)	
International application No. PCT/EP 03/08354	International filing date (day/month/year) 29.07.2003	Priority date (day/month/year) 01.08.2002
International Patent Classification (IPC) or both national classification and IPC H01J49/04		
Applicant MICROSAIC SYSTEMS LIMITED et al.		
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 7 sheets.</p>		
<p>3. This report contains indications relating to the following items:</p> <p>I <input checked="" type="checkbox"/> Basis of the opinion</p> <p>II <input type="checkbox"/> Priority</p> <p>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p>IV <input type="checkbox"/> Lack of unity of invention</p> <p>V <input checked="" type="checkbox"/> Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p>VI <input type="checkbox"/> Certain documents cited</p> <p>VII <input type="checkbox"/> Certain defects in the international application</p> <p>VIII <input type="checkbox"/> Certain observations on the international application</p>		
Date of submission of the demand 01.03.2004	Date of completion of this report 20.01.2005	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Van den Berg, G Telephone No. +49 89 2399-2499 	

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/EP 03/08354**

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-23 as originally filed

Claims, Numbers

1-38 received on 06.12.2004 with letter of 06.12.2003

Drawings, Sheets

1/11-11/11 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
☐ the language of publication of the international application (under Rule 48.3(b)).
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority in written form.
☐ furnished subsequently to this Authority in computer readable form.
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

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5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1 - 38
	No: Claims	
Inventive step (IS)	Yes: Claims	1 - 38
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1 - 38
	No: Claims	

2. Citations and explanations

see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/EP 03/08354

To point V:

Reference is made to the following documents cited in the International Search Report:

- D1 = MICRO ELECTRO MECHANICAL SYSTEMS, 1998, MEMS. 98.
PROCEEDINGS, THE ELEVENTH ANNUAL INTERNATIONAL
WORKSHOP ON HEIDELBERG, GERMANY 25 - 29 January 1998, NY,
USA, IEEE, pages 438 - 442; "Silicon micromachined mass filter for a low
power, low cost quadruple mass spectrometer", 25 January 1998.
- D2 = US 6 025 591 A (cited in the underlying application)
- D3 = US 5 386 115 A

Document D1 describes

an integrated mass spectrometer device (mass filter) formed from two multilayer wafers, each wafer having an inner layer, an outer layer and having an insulating silicon layer provided therebetween, the device having a plurality of electrode rods (spacers in the form of insulating cylindrical rods) and a plurality of electrodes (metallised silica rods), the electrodes and electrode rods being formed on distinct layers of the wafers (cf. D1, figure 1) one (two) of which being dimensioned to receive the electrode rods.

Similarly, D1 discloses

a method of forming a mass spectrometer comprising the steps of
etching an inner and outer pattern on a wafer, the inner and outer patterns defining components of the spectrometer,
bonding the wafer to a second wafer so as to form multilayer stack device,
inserting at least one insulating cylindrical rod into the device
providing at least one metallised fibre rod electrode in the device
and wherein the at least one electrode and the at least one electrode rod are provided on distinct layers of the wafers, one (two) of which being dimensioned to receive the electrode rods.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

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(Novelty)

The subject-matter of claim 1 (34) differs from the disclosure of document D1 in that the rods are being retained in contact with the second layer by the provision of at least one resilient member formed in the second layer.

Therefore, the subject-matter of claims 1 and 34 and of the claims depending on them meet the requirement of Article 33(2) PCT.

2. (Inventive step)

In view of the technical problem posed in the underlying application (cf. description, page 5, lines 21 - 26 in combination with the drawbacks of the prior art described on pages 1 - 5), the provision of resilient members (please see, for example, present claim 4; figures 2 - 6) is one aspect of solving that problem. The available prior art (documents cited in the International Search Report do not seem to suggest such solution for the aforementioned purpose.

As a consequence, the subject-matter of claims 1 and 34, and hence that of the dependent claims, meets the requirement of Article 33(3) PCT.

3. (Industrial applicability)

Insofar as the claims as a whole can be understood, it seems that they concern matter that is industrially applicable such that the requirement of Article 33(4) PCT would be met.

Additional observations:

1. The independent claims are not clear (Article 6 PCT).

1.1 The configuration of (planar) electrodes and electrodes rods in the integrated mass spectrometer device is not clear. It is further not clear what distinguishes electrodes from electrode rods.

1.2 The independent claims are not in the two-part form (Rule 6.3 PCT).

**INTERNATIONAL PRELIMINARY
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1.3 Claims 5 and 13 are formulated in terms of a product-by-process.

1.4 The claims are not provided with reference signs (Rule 6.2.(b) PCT).

Claims

1. An integrated mass spectrometer device formed from two
5 multilayer wafers, each wafer having an first layer, a
second layer and having an insulating layer provided
therebetween, the device having a plurality of
electrode rods and a plurality of planar electrodes,
the electrodes being formed in the first layer and
10 electrode rods being provided in the second layer, the
second layer being dimensioned to receive the electrode
rods, the rods being retained in contact with the
second layer by the provision of at least one resilient
member formed in the second layer..
- 15
2. The device as claimed in claim 1 wherein each of the
multilayer wafers has three layers which are combined
to form a five layer structure.
- 20
3. The device as claimed in claim 1 or 2 wherein the
electrode rods are mountable in the second layers of
each wafer.
- 25
4. The device as claimed in claim 1 wherein the at least
one resilient member is provided by a spring formed in
the wafer.
- 30
5. The device as claimed in claim 1 wherein the electrode
rods are located by etched features in the second layer
of the wafer, the features being dimensioned so as to
suitably receive a rod, and wherein the resilient
members is formed by also etching the second layer.

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6.The device as claimed in any preceding claim wherein each of the first and second wafers are patterned with an outer pattern provided on the second layer, and an inner pattern provided on the first layer.

5

7.The device as claimed in claim 6 wherein the patterns provided on the first layer provide for ion source and ion collection components of the spectrometer.

10 8.The device as claimed in claim 6 or 7 wherein the insulating layer is provided in regions where the patterns overlap.

15 9.The device as claimed in any preceding claim wherein the first and second wafers are bonded to form a monolithic block.

20 10.The device as claimed in claim 9 wherein the bonding of the first and second wafers is effected such that the electrode rods are located on an outer portion of the block and the electrodes in an inner portion of the block.

25 11.The device as claimed in any preceding claim wherein the electrode rods form a mass filter component of the mass spectrometer.

30 12.The device as claimed in claim 11 including four cylindrical electrode rods, each rod having its diameter and centre-to-centre separation correctly chosen for quadrupole operation.

13.The device as claimed in claim 11 or 12 wherein the horizontal separation of the cylindrical electrodes

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within each wafer is defined by lithography and deep reactive ion etching.

14. The device as claimed in any one of claims 11 to 14
5 wherein the vertical separation of the cylindrical electrodes is defined by the combined thickness of the two bonded wafers.
15. The device as claimed in any preceding claim wherein
10 at least some of the plurality of electrodes are adapted to form ion entrance optics.
16. The device as claimed in claim 15 wherein the ion
entrance optics are formed by an einzel lens.
15
17. The device as claimed in claim 15 further including a cold cathode field emission electron source provided in front of the ion entrance optics.
- 20 18. The device as claimed in claim 15 further including an electron source selected from one of:
a) a hot-cathode source,
b) a DC discharge source,
c) an AC discharge source,
25 d) an electrospray source.
19. The device as claimed in claim 15 wherein a pair of RF electrodes are placed in front of the ion entrance optics in order to create a plasma.
30
20. The device as claimed in claim 15 wherein the ion entrance optics are formed from an etched fluid channel combined with a set of electrodes that together define an electrospray source.

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21.The device as claimed in any preceding claim wherein each of the wafers are bonded silicon on insulator wafers.

5

22.The device as claimed in any preceding claim further including two or more distinct chambers, the provision of distinct chambers enabling the use of the device within a differentially pumped system.

10

23.The device as claimed in any preceding claim further including an ion source provided in a mesh configuration.

15

24.The device as claimed in any preceding claim wherein at least some of the plurality of electrodes are arranged in a mesh configuration.

20

25.The device as claimed in any one of claims 1 to 22 wherein at least some of the plurality of electrodes are arranged in a tube arrangement.

25

26.The device as claimed in claim 25 wherein the tube arrangement provides a lens located at at least one of the entrance or exit to the electrode rods.

30

27.The device as claimed in any preceding claim wherein at least some of the plurality of electrode rods are configured as ion reflectors.

28.The device as claimed in claim 27 wherein the ion reflectors are configured to provide a linear ion trap.

29.The device as claimed in any preceding claim further

including a filament element adapted to provide a source of electrons, the filament element being configured as one of the following types:

- 5 a) an externally provided filament,
b) an integrally formed filament, or
c) a removable filament.

30.A mass spectrometer system including a device as claimed in claim 1 in combination with an ion source and/or an ion detector, at least one of the ion source and/or ion detector being provided externally to the device.

15 31.A mass spectrometer array comprising a plurality of devices as claimed in any preceding claim.

32.A mass spectrometer system comprising two or more devices as claimed in any one of claims 1 to 29, the two or more devices being provided in series so as to form a tandem mass spectrometer.

33.A mass spectrometer system as claimed in claim 32, wherein each of the devices forming the series of devices is a quadropole device and wherein a pair of RF electrodes are placed between the cascaded quadrupole devices in order to create a plasma.

34.A method of forming a mass spectrometer comprising the steps of:

- 30 a) Providing a first and second wafer, each wafer having at least three layers, a first layer, a second layer and an insulating layer provided therebetween,

b) On each wafer, etching an inner and outer

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- 5 pattern on the first and second layers
respectively, , the inner and outer patterns
defining components for the spectrometer, the
first layer of each wafer having at least one
electrode formed thereon, the second layer of
each wafer being dimensioned to receive at
least one electrode rod, the second layer
having at least one resilient member formed
therein, the at least one resilient member
10 being adapted to retain a rod in contact with
the second layer,
- c) Subsequently bonding the two patterned wafers
together so as to form a multilayer stack
device,
- 15 d) inserting at least one electrode rod into the
second layer of each wafer of device.

35.A method as claimed in claim 34 wherein at least one
of the distinct layers is provided by an etching step
20 including at least two masks.

36.A method as claimed in claim 34 or 35 wherein the step
of providing the at least one electrode includes the
provision of the at least one electrode in at least one
25 of the following configurations:

- a) a tube arrangement,
- b) a mesh arrangement, and/or
- c) a diaphragm electrode arrangement.

30 37.A method as claimed in claim 36 wherein a mesh
arrangement is provided so as to define at least a
portion of a perimeter of a source cage into which
electrons may be injected from an external filament.

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1. 11

38.A method as claimed in claim 36 wherein the diaphragm electrode arrangement is provided in the form of a three-electrode configuration, inner and outer electrodes of the three electrode configuration being configured to

5 operate at the same potential.

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